

**WHAT IS CLAIMED IS:**

1. A method of withdrawal and return of blood in a patient undergoing extracorporeal blood treatment therapy comprising:
  - a. inserting a blood withdrawal catheter into a surface peripheral vein in the patient's arm;
  - b. advancing the catheter into a venous tree of the patient towards the heart a distance in a range of 20 to 65 cm;
  - c. continuously drawing blood from the catheter;
  - d. applying an extracorporeal treatment to the blood, and
  - e. returning the treated blood to the patient.
2. A method as in 1 where the treatment is ultrafiltration.
3. A method as in 1 where the treatment is hemofiltration.
4. A method as in 1 where the treatment is dialysis.
5. A method as in 1 where the treatment is selected from a group consisting of collecting platelet, collecting peripheral blood stem cells and performing a therapeutic apheresis procedure.
6. A method of extracorporeal circulation of blood for medical therapy treatment therapy comprising:
  - a. inserting a blood withdrawal catheter into a surface peripheral vein in an arm of a patient;
  - b. advancing the catheter into a venous tree of the patient and towards a heart until the catheter tip at least reaches an auxiliary vein;
  - c. drawing blood from the tip of the catheter;
  - d. applying extracorporeal treatment to the blood, and
  - e. returning the treated blood to the patient.
7. A method as in claim 6 where the catheter is inserted a length a range of 20 to 65 cm into the peripheral vein and venous tree.

8. A method as in claim 6 where the insertion of the catheter is at the elbow level of the arm.

9. A method as in claim 6 where a withdrawal opening of the catheter is in one of an auxiliary vein, a subclavian vein, a vena cava, and a right atrium of the heart.

10. A method as in claim 6 wherein the catheter has an outside diameter in a range of 1.0 to 1.75 mm.

11. A method as in claim 6 wherein the catheter has a total tube length no greater than 75 cm.

12. A method as in claim 6 wherein the catheter has a catheter lumen internal diameter in a range of 0.9 to and including 1.2 mm.

13. A method of continuous extracorporeal circulation of blood for medical treatment therapy comprising:

- a. inserting a blood withdrawal catheter into a surface peripheral vein in an extremity of the patient;
- b. advancing the catheter into a venous tree of the patient and towards a heart of the patient until a catheter tip has substantially passed venous valves in the venous tree;
- c. withdrawing blood from the tip of a catheter in a retrograde flow direction;
- d. applying extracorporeal treatment to the withdrawn blood;
- e. returning blood to the patient.

14. A method as in claim 13, where substantial negative pressure is applied to the catheter to overcome resistance of the catheter to blood flow.

15. A method as in claim 13 where airtight compression seals are established between a pump intake and the catheter.

16. A method as in claim 13 where the extracorporeal treatment step further comprises:

e. coupling a blood withdrawal tube to the catheter and to a filter, and passing withdrawn blood through the filter to separate excess fluid from the blood.

17. A method as in claim 16 wherein a blood flow through the filter is less than two percent of a total cardiac output of the patient, and a flow of the excess fluid removed from the blood is in a range of 250 to 750 milliliters per hour.

18. A method as in claim 13 wherein the reduced pressure draws blood from the reservoir of blood upstream through the vein into the withdrawal catheter.

19. A method as in claim 13 wherein the blood withdrawal catheter is a peripherally inserted central catheter (PICC).

20. A method as in claim 19 wherein the PICC catheter is at least 25 centimeters long.

21. A method as in claim 13, wherein a rate of the removal of blood is no greater or equal than 40 milliliters per minute.

22. A method as in claim 13, wherein a rate of the removal of blood is in a range of 40 to 60 milliliters per minute, and a rate of removal of the excess fluid is in a range of 0.1 to 1.0 liters per hour.

23. A method as in claim 13, wherein the surface peripheral blood vessel is a basilic vein.

24. A method as in claim 13, wherein the surface peripheral blood vessel is a cephalic vein.

25. A method as in claim 13, wherein the filtration is ultrafiltration.

26. A method as in claim 25, wherein the extracorporeal treatment is to pass the withdrawn blood through a filter to remove fluids from the blood.

27. A method as in claim 26, wherein the filter includes capillary hollow fibers have filtering pores which retain in the blood solutes greater than 50,000 Daltons.

28. A method as in claim 26, wherein the hollow fibers have blood passages of approximately 0.2 mm or less in diameter.

29. A method as in claim 26, wherein blood flows continuously through the filter during periods when a blood pump is reducing pressure on the withdrawal catheter.

30. A method for removing excess water from a patient comprising the steps of:

- a. inserting a blood withdrawal catheter in a peripheral vein and maneuvering the catheter through the vein and vascular system of the patient to access a reservoir of blood in the large or great veins for continuous blood withdrawal;

- b. drawing blood from the reservoir of blood into the withdrawal catheter and into a withdrawal blood tube of an extracorporeal blood circuit;

- c. applying a reduced pressure to the withdrawal blood tube to cause blood to flow into the blood withdrawal catheter.

- d. condensing the removed blood through a filter to separate the excess water from the blood;

- e. returning the condensed blood into a second peripheral blood vessel in the patient, and

- f. wherein a blood flow through the filter is less than two percent of a total cardiac output of the patient, and a flow of the excess fluid removed from the blood is in a range of 0.1 to 1.0 liters per hour.

31. A method as in claim 30 wherein the reduced pressure induces retrograde blood flow into the withdrawal catheter.

32. A method as in claim 30 further wherein the insertion of the withdrawal catheter includes first inserting an introducer catheter into the vein and then inserting the blood withdrawal catheter through the introducer catheter.

33. A method as in claim 30 wherein the withdrawal catheter is maneuvered through the vein to a point in the vein beyond venous flapper valves.

34. A method as in claim 30 wherein the blood withdrawal catheter is a peripherally inserted central catheter (PICC).

35. A method as in claim 34 wherein the PICC catheter is at least 25 centimeters (cm) long and no greater than 65 cm long.

36. A fluid removal apparatus comprising:

a blood removal catheter for insertion into a peripheral vein and having a size 16 standard gage needle or less, wherein the blood removal catheter has a length in a range of 20 to 65 cm;

a pump connected between the blood removal catheter and the filter;

a filter having a blood inlet port coupled to the blood removal catheter, a blood outlet port, an excess fluid removal port, and a blood flow passage with porous membrane which passes fluids to the fluid removal port and retains solutes of 50,000 Daltons or greater, and

a blood return catheter for inserting into a peripheral vein or artery and having a size of 16 standard gage needle or less.

37. A fluid removal apparatus as in claim 36 wherein the blood removal catheter is a Peripherally Inserted Central Catheter (PICC).

38. A fluid removal apparatus as in claim 36 wherein the blood removal catheter has a diameter in a range of and including 0.5 millimeters to 1.5 millimeters.

39. A fluid removal apparatus as in claim 36 wherein the blood pump applies a negative pressure in a range of and including negative 100 to negative 300 millimeters of mercury.

40. A fluid removal apparatus as in claim 36 wherein the blood pump applies a negative pressure in a range of and including negative 150 to negative 200 millimeters of mercury.

41. A fluid removal apparatus as in claim 37 wherein the internal diameter of the PICC catheter is no more than 1.1 millimeters.

42. An apparatus for removing excess fluid from a patient comprising:

- a blood removal catheter for insertion into a first peripheral vein of the patient, wherein the blood removal catheter is a long peripheral venous access cannula;

- a filter having a blood inlet port in fluid communication with the blood removal catheter to receive blood removed directly from the first peripheral vein or artery, a blood outlet port, an excess fluid removal port, and a filter membrane between the fluid removal port and the blood inlet and outlet ports, wherein the filter membrane is sized to pass excess fluid from blood flowing through the filter at a rate in a range of 100 milliliters per hour (mL/hour) to 700 mL/hour, and

- a blood return catheter in fluid communication with the blood outlet port and for inserting into a second peripheral vein or artery of the patient.

43. A fluid removal apparatus as in claim 42 wherein the blood removal catheter is a Peripherally Inserted Central Catheter (PICC).

44. A fluid removal apparatus as in claim 42 wherein the blood removal catheter has a diameter in a range of and including 0.5 millimeters to 1.5 millimeters.

45. A fluid removal apparatus as in claim 42 wherein the blood pump applies a negative pressure in a range of and including negative 100 to negative 300 millimeters of mercury.

46. A fluid removal apparatus as in claim 42 wherein the blood pump applies a negative pressure in a range of and including negative 150 to negative 200 millimeters of mercury.

47. A fluid removal apparatus as in claim 43 wherein the internal diameter of the PICC catheter is no more than 1.1 millimeters.

48. A catheter for insertion into a peripheral vein of a patient for continuous withdrawal of blood as a part of extracorporeal blood circulation circuit where said catheter is:

- a. 20 to 65 cm long;
- b. has internal lumen of 0.9 to 1.2 mm in diameter;
- c. includes an air tight connector for connection to blood withdrawal tubing with a compression seal.

49. A catheter as in claim 48, where said compression seal is a silicon ring.

50. A catheter as in claim 48, where said catheter is formed of urethane.

51. A catheter as in claim 48, where said compression seal is compressed between flat surfaces of a catheter hub and a blood tubing connector.

52. An extracorporeal method for treating blood from a patient comprising the steps of:

- a. inserting a blood withdrawal catheter in a peripheral vein and maneuvering the catheter through the vein of the patient to access a reservoir of blood in the large or great veins for continuous blood withdrawal;

b. continuously drawing blood from the reservoir of blood into the withdrawal catheter and into a withdrawal blood tube of an extracorporeal blood circuit, and

c. applying a reduced pressure to the withdrawal blood tube to cause blood to flow into the blood withdrawal catheter.